Claims

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1. A system for controlling a load-lifting apparatus (1), having a controllable drive (2), having a load-bearing element (5) which is connected to the drive (2) and is aligned vertically (Z-Z) - as a result of gravitational force at least in a rest position - having a load-receiving device (7) which is connected to the load-bearing element (5), and having a regulating circuit for load-balancing purposes, characterized in that the regulating circuit for load-balancing purposes comprises a device (11) for generating a path-dependent signal (S), which corresponds to an essentially vertical (Z-Z) movement of the load-bearing element (5) and serves as an input signal for controlling the drive (2).

2. The system as claimed in claim 1, characterized in that the drive (2) is an electric motor and has the device (11) for generating the path-dependent signal (S), and is designed, in particular, as an electric servomotor.

3. The system as claimed in claim 1, characterized in that the drive (2) is a fluidically acting drive device, such as a pneumatic piston/cylinder arrangement or a pneumatically activated recirculating ball screw.

4. The system as claimed in one of claims 1 to 3, characterized in that the load-bearing element (5) is designed, at least in part, rigidly, e.g. as a rack.

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5. The system as claimed in one of claims 1 to 4, characterized in that the load-bearing element (5) comprises a load-bearing parallelogram in which four sub-arms are connected to one another at

joints with a horizontal pivot axis, it being possible to change preferably the angle position and the lengths of the sub-arms of the load-bearing parallelogram located within a vertical plane.

6. The system as claimed in one of claims 1 to 3, characterized in that the load-bearing element (5) can be wound up flexibly and on a drum (6).

7. The system as claimed in one of claims 1 to 6, characterized in that the path-dependent signal (S) corresponds to an angle of rotation ($\alpha$), in particular to an angle of rotation of the drum (6) or to an angle by which in each case two sub-arms of the load-bearing parallelogram, which are connected to one another via a joint, move in relation to one another.

8. The system as claimed in one of claims 1 to 7, characterized in that the device (11) for generating the path-dependent signal (S) is an incremental encoder which is arranged coaxially with the drum (6), with the drive shaft of the drive (2), such as the drive shaft of an electric motor, or with a deflecting disk or with a pivot axis of joints of a load-bearing parallelogram.

9. The system as claimed in one of claims 1 to 8, characterized in that the regulating circuit comprises a regulating member (12) which is designed such that, in dependence on a deviation ($\Delta S$) of the path-dependent signal (S) from a desired value (W), it emits, to an actuating member (13) for the drive (2), a regulating signal (R) for the vertical (Z-Z) movement of the load-bearing element (5).

10. The system, in particular as claimed in one of

claims 1 to 9, characterized by a controller for the vertical (Z-Z) movement of the load-bearing element (5), comprising a control member (14), a handling device (10) for the/a load-receiving device (7) and a device (15) for generating a force-dependent signal (P), which corresponds to a manipulation force (F) acting essentially vertically (Z-Z) on the handling device (10), the control member (14) being designed such that, in dependence on a deviation (ΔP) of the force-dependent signal (P) from a desired value (V), it emits a control signal (T) for the/a drive (2) for the purpose of initiating a vertical (Z-Z) movement of the load-bearing element (5), said movement corresponding to the direction and preferably also the magnitude of the manipulation force (F).

11. The system as claimed in claim 10, characterized in that the handling device (10) comprises at least two main parts (101, 102), of which the first part (101) is connected in a fixed manner, on the one hand, to the load-bearing element (5) and, on the other hand, to the load-receiving device (7) and the second part (102), on which the manipulation force (F) acts, is arranged such that it can be moved relative to the first part (101), there being arranged, as the device (15) for generating the force-dependent signal (P), in or on the handling device (10) at least one, preferably inductive, displacement sensor for sensing the change in position (ΔH) of the two parts (101, 102) relative to one another which occurs under the action of the manipulation force (F).

12. The system, in particular as claimed in claim 10 or 11, characterized by a setting member (16) which is connected, in particular, to the/a drive

(2), or the actuating member (13) thereof, and, in dependence on a signal (I, Q) corresponding to a load (9) and/or on the/a path-dependent signal (S), which corresponds to an essentially vertical (Z-Z) movement of the/a load-bearing element (5), changes the/a desired value (V) for the/a force signal (P), which corresponds to the/a manipulation force (F) acting vertically (Z-Z) on the/a handling device (10), and/or changes the transmission behavior of the/a control member (14), which, in dependence on the/a deviation (ΔP) of the force signal (P) from the desired value (V), emits the/a control signal (T) for the/a drive (2) for the purpose of initiating a vertical (Z-Z) movement of the load-bearing element (5).

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13. The system as claimed in one or more of claims 1 to 12, characterized by at least one fluidically, in particular pneumatically, acting brake (20) for the load-bearing element (5), having a cylinder-like housing (21), having a cover (22), which closes off the housing (21) on the top side, and a base plate (23), which closes off the housing (21) on the underside, and having a piston (24) which is guided such that it can be moved longitudinally in the housing (21) and subdivides the housing (21) into a sealed pressure chamber (25) for a pressure-generating fluid and into a spring chamber (26), the cover (22), base plate (23) and piston (24) each having a lead-through opening for the load-bearing element (5), there being arranged in the spring chamber (26), around the load-bearing element (5), at least two blocking elements (27), in particular balls, which are subjected to the action, on the one hand, of springs (28) and, on the other hand, of the piston (24) under the fluid-pressure action, the spring chamber 0(26) having a region (29) which tapers in the direction of the piston (24) such that the

blocking elements (27), when they are located in a spring-side part of the region (29), in the presence of the fluid-pressure action, release the load-bearing element (5) and, when they are moved into a piston-side part of the region (29) under the action of the springs (28), in the absence of the fluid-pressure action, arrest the load-bearing element (5) in the housing (21).

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14. The system as claimed in claim 13, characterized in that the path-dependent signal (S), which corresponds to an essentially vertical (Z-Z) movement of the load-bearing element (5), serves as an input signal for controlling the brake (20), in particular for opening a pressure-relief valve for the pressure chamber (25).

15. The system as claimed in claim 13 or 14, characterized by two brakes (20) which are installed in positions rotated through 180° in relation to one another.

16. The system as claimed in one or more of claims 1 to 15, characterized by a safety controller for the drive (2) and/or for blocking the vertical (Z-Z) movement of the load-bearing element (5), said controller having a sensor (18), in particular a light barrier, for registering the use of the handling device (10) and also having a switching member (19) which switches off the drive (2) and/or blocks the vertical (Z-Z) movement of the load-bearing element (5) and only switches on and/or releases the same (signal U) when the sensor (19) signals the use of the handling device (10) (signal A).

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17. The system as claimed in one or more of claims 10 to 16, characterized by a safety controller for a manually operable load-receiving mechanism, in

particular for a clamping or gripping mechanism, of the load-receiving device (10), the safety controller having a safety control member (17) which is connected to the device (11) for generating the path-dependent signal (S) and the device (15) for generating the force-dependent signal (P) and blocks the manual operation of the load-receiving mechanism and only releases it (signal B) when, in the presence of the force-dependent signal (P), there is no path-dependent signal (S) present.

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18. The system as claimed in one or more of claims 9 to 17, characterized in that the regulating member (12) of the regulating circuit for load-balancing purposes and/or the control member (14) of the controller for the vertical (Z-Z) movement of the load-bearing element (5) and/or the setting member (16) for the desired value (V) of said controller and/or the switching member (19) of the safety controller for the drive (2) and/or for blocking the load-bearing element (5) and/or the safety control member (17) of the safety controller is a constituent part/are constituent parts of a programmable controller (SPS).

19. The system as claimed in claim 18, characterized in that the programmable controller (SPS) is arranged in the vicinity of the drive (2), in particular in a lifting subassembly (3) which accommodates the drive (2).

20. The system as claimed in one or more of claims 1 to 19, characterized by an exchangeable storage battery for the power supply of the regulating circuit for load-balancing purposes, of the controller for the vertical (Z-Z) movement of the load-bearing element (5), of the safety controller(s) and/or of the programmable

controller (SPS), in particular in the presence of a fluidically acting drive device.

21. The system as claimed in claim 20, characterized in that the storage battery is arranged on or in the handling device (10).

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22. The system as claimed in one or more of claims 1 to 21, characterized by a crane trolley which is guided on a running-rail structure (4) in at least one horizontal (X-X) direction.

23. The system as claimed in one or more of claims 1 to 22, characterized in that, for its movements in the horizontal direction (X-X and Y-Y), the load-lifting apparatus (1) is assigned at least one drive device which can be activated in dependence on a forced deflection of the load-bearing element (5) - said deflection being based on the vertical alignment (Z-Z) which is established automatically as a result of gravitational force in the rest position.

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24. A method of controlling a load-lifting apparatus (1), in particular by means of a system as claimed in one or more of claims 1 to 23, characterized in that, once a load (9) has been received, a force applied by a/the drive (2) or a corresponding torque is rapidly increased automatically until it corresponds to the weight of the load (9), it being the case that, in order to determine that a balanced state for the load (9), once reached, has been set, a path-dependent signal (S) for an essentially vertical (Z-Z) movement of a/the load-bearing element (5) is determined.

25. The method as claimed in claim 24, characterized in that the path-dependent signal (S) is compared with a desired value (W) and, when the signal (S)

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~~and desired value (W) correspond ($\Delta S = 0$), the force applied by the drive (2) or the torque is kept constant at the value reached.~~

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